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(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
10 May 2001 (10.05.2001)

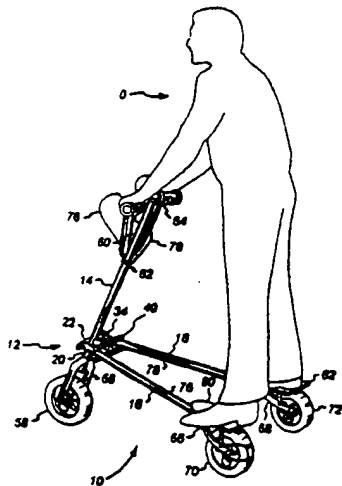
PCT

(10) International Publication Number
WO 01/32470 A3

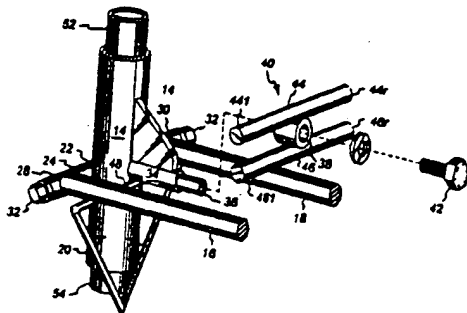
- (51) International Patent Classification⁷: **B62M 1/00** (74) Agent: LITMAN, Richard, C.: Litman Law Offices, Ltd., P.O. Box 15035, Crystal City Station, Arlington, VA 22215-0035 (US).
- (21) International Application Number: PCT/US00/41844
- (22) International Filing Date:
3 November 2000 (03.11.2000) (81) Designated States (*national*): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
09/434,371 5 November 1999 (05.11.1999) US (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
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[Continued on next page]

(54) Title: CAMBERING VEHICLE AND MECHANISM



(57) Abstract: A cambering vehicle includes a single steerable front wheel (58) and a pair of rear wheels (70, 72) at the rearward ends of trailing arms (16, 18) extending from the front structure. The two arms are articulated to the front structure, and move arcuately in plane parallel to the steering column. In one embodiment the arms are linked by a yoke (40), and traverse equal arcuate distances in opposite directions relative to one another. In another embodiment the yoke is replaced by a transverse link (140), with elastomer bushing (141, 143) connecting the link ends to their respective arms. The vehicle operates using the principle of conservation of angular momentum, with the vehicle travelling a sinusoidal path and the operator leaning to the inside of the turn. This moves the center of gravity of the vehicle and operator to the inside of the turn, thus accelerating vehicle and operator along the turning path to increase velocity of the device.



WO 01/32470 A3



Published:

- with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(88) Date of publication of the international search report:

10 January 2002

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/41844

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : B62M 1/00

US CL : Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 280/87.041, 87.042, 87.05, 639, 40, 652, 655, 659, dig 6, 124.11, 124.111; 403/61, 59, 52, 53, 151

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 1,336,100 A (SHEARER) 06 April 1920, (06.04.1920), whole document.	1-381
A	US 1,664,858 A (HEADLEY) 03 April 1928, (03.04.1928), whole document.	1-381
A	US 1,890,755 A (SHEPHERD) 13 December 1932, (13.12.1932), whole document.	1-381

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	*T* later documents published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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O document referring to an oral disclosure, use, exhibition or other means	
P document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

04 MAY 2001

Date of mailing of the international search report

04 JUN 2001

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 305-3230

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/41844

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

280/87.041, 87.042, 87.05, 639, 40, 652, 655, 659, dig 6, 124.11, 124.111; 403/61, 59, 52, 53, 151

shown in other drawing Figures. The sleeves 145 and 147 of each bushing are affixed to the elastic material 149 therebetween, with relative motion of the two sleeves 145 and 147 of each bushing being allowed only due to the resilience of the elastomer 149; no other mechanical or other motion is provided for by the bushings.

The outer sleeves 145 of the bushings 141 and 143 are in turn immovably affixed (pressed in place, etc.) within the retaining bosses 117, 119 of the two trailing arms 116, 118, with the inner sleeves 147 of the elastomer bushings being immovably affixed to the opposite ends of the transverse link 140, e. g., by tightly securing the axial retaining bolts 151 therethrough. Thus, the only provision for relative motion between the link 140 and the two trailing arms 116, 118 is by means of the resilience of the elastomer inserts 149 of the bushings 141 and 143.

Figures 8A through 8D illustrate the action of the link 140 and the flexing of the elastomer insert material 149 within the bushings 141 and 143. Figure 8A illustrates the configuration of the transverse link 140 and its attached bushings 141 and 143 and respectively attached trailing arm bosses 117 and 119, when the right trailing arm 118 is deflected downwardly and the left arm 116 is correspondingly and equally deflected upwardly. The rigidity of the link 140 results in its rocking back and forth arcuately about its attachment boss or passage 138, secured to the front column 114 by the link attachment point 134 and bolt or pin 142. However, the relative motion between the link ends and the trailing arm lugs 117 and 119 is absorbed by the elastomer material 149 of the respective two bushings 141 and 143; the deflection of the elastomer material 149 is clearly shown in Figure 8A. While the elastomer material 149 allows some arcuate and pivotal freedom of motion between the link ends and the trailing arms 116 and 118, the link 140 and trailing arms 116, 118 remain directly, but resiliently, connected.

It will be seen that if all differential forces to the two trailing arms 116, 118 are released, that the resilience of the elastomer material 149 within the two elastomer bushings 141, 143 will apply a restoring force to urge the two trailing arms 116, 118 to center to a generally parallel orientation relative to one another as the resilient forces within the elastomer material 149

equalize. The rest state of this embodiment is illustrated in Figure 8B of the drawings, where the elastomer material 149 is disposed equally within each bushing 141 and 143, with no appreciable distortion.

5 This provides certain benefits for the cambering vehicle equipped with the link 140 and elastomer connecting means 141, 143 of Figures 6 through 8D. First of all, since there are no relatively sliding components between the link ends and the trailing arms, there is no need for lubrication at these junctures.
10 Secondly, the increasing resistance of the elastomer material 149 as the trailing arms 116, 118 are deflected to a greater angular difference between the two, results in a restorative force which assists in stabilizing the vehicle and preventing too great a deflection between the two arms 116 and 118 and resulting collapse
15 of the vehicle. The prevention of excessive angular difference between the two arms 16 and 18 of the vehicle 10 of Figure 1 requires a stop brace 50, with the increasing resistance of the elastomer 149 precluding any requirement for such a stop brace for the transverse link and elastomer connecting means embodiment
20 illustrated in Figures 6 through 8D.

Another advantage is that the elastomer joints serve to cushion asymmetrical impact forces incurred when traversing rough surfaces. While the tires of the vehicle absorb such impacts and forces where the vehicle is equipped with tires (as opposed to
25 skates, skis, etc.), the resilience of the elastomer material provides further shock absorption capability to cushion the forces imparted to the various mechanisms of the vehicle.

Finally, the equalizing forces developed by the elastic material 149 as it attempts to neutralize the positions of the two
30 trailing arms 116 and 118, result in the vehicle remaining in an upright stance when all forces are removed therefrom, as when parked upright or placed at rest. The resilience of the two elastomer inserts 149 of the bushings 141 and 143, tend to prevent the two arms 116 and 118 from deflecting relative to one another,
35 thus holding the vehicle in an upright position at rest without need for any additional support means.

Figure 8C illustrates the link 140, bushing 141 and 143, and trailing arm boss 117, 119 configuration when the left arm 116 is

deflected downwardly with the right arm taking a resultant upward deflection, i. e., a situation opposite that shown in Figure 8A. The deflection of the elastomer material 149 in the two elastomer bushings 141, 143 will be seen to be opposite that shown in Figure 8A, where the trailing arms 116, 118 are deflected in the opposite direction. The result is still a restorative force which urges the two trailing arms 116, 118 back to the neutral position illustrated in Figure 8B.

Figure 8D illustrates the clockwise and counterclockwise pivoting of the transverse link 140 about its link bushing or attachment 138, as would occur during normal operation of the vehicle equipped with the link 140 and bushings 141, 143. The alternating upward and downward deflection of the two trailing arms 116, 118 during the sinusoidal travel of the vehicle, results in the rocking back and forth of the transverse link 140, with the two elastomer bushings 141, 143 constantly applying a restorative force attempting to neutralize the position of the two arms 116, 118 back to the neutral position of Figure 8B.

The operator of the vehicle need only swing his or her body inwardly toward the center of the arcuate path traveled by the vehicle, in order to overcome this centering force and accelerate the vehicle due to the principle of conservation of momentum, as discussed further above. The restorative force developed by the two elastomer bushings 141, 143 is relatively easily overcome during vehicle operation, yet provides sufficient resistance to restrict trailing arm travel beyond a certain point and to hold the vehicle in an upright position when parked. The resistance of the bushings 141, 143 may be adjusted as desired by adjusting the inner and outer diameter of the elastomer material 149, the length of the bushings 141 and 143, and/or the durometer of the elastic material 149, as desired.

In summary, the present cambering vehicle and its novel yoke mechanism for controlling opposite arcuate motion of the two trailing arms, provides a more efficient and cleaner means of providing for the control of such motion as required in such vehicles. The unitary, monolithic construction of the yoke mechanism of conventional weldments, results in a simple, inexpensive, and easily constructed unit, with no other parts or

components being required to affect the required action of the trailing arms. Another advantage to the present mechanism is its attachment and ease of removal by means of a single pivot bolt, which enables the vehicle to be folded to an essentially flat configuration for storage. The yoke may be reinstalled upon its attachment point to the rear of the forward column to preclude its loss during storage, after being removed from the trailing arms.

The present vehicle may be constructed in the same manner as the yoke mechanism described above, i. e., welded up of conventional metal tubular stock, as shown in the drawing Figures. Other construction means (e. g., stampings, carbon fiber and/or other composites, etc.) may be used for large scale production, if so desired. The present cambering vehicle and its yoke mechanism provide a much needed improvement in efficiency of construction for such devices, with its operation providing excellent exercise, as well as transportation, for the operator.

In another embodiment, the yoke assembly is replaced with a rigid transverse link having elastomer end bushings which are installed in cooperating fittings within the trailing arms. No relative mechanical motion is permitted between any of the rigid components of the link and trailing arms. Rather, all relative motion is taken up by the elastomer material within the bushings. This provides several advantages, i. e., (1) no lubrication is required, as there is no relative motion between wearing parts; (2) the bushings constantly seek to return the trailing arms to a neutral configuration where they are parallel to one another, thus stabilizing the vehicle to a great extent; (3) this restorative force allows the vehicle to be parked upright, without need for additional parking stands or the like; and (4) the elastomer provides additional cushioning and shock absorbing properties, for a smoother ride and for resisting shock damage to various components. Whether the yoke or elastomer bushing and transverse link embodiment is used, the present cambering vehicle embodiments provide numerous advantages and benefits over other cambering vehicles of the prior art.

It is to be understood that the present invention is not limited to the sole embodiment described above, but encompasses any and all embodiments within the scope of the following claims.

CLAIMS

I claim:

1. A cambering vehicle, comprising:
 - a frame comprising a front column and a left and a right trailing arm;
5 said front column having an upper end and a lower end opposite said upper end;
each said trailing arm having a forward end and a rearward end opposite said forward end;
 - 10 a left and a right trailing arm attachment point disposed opposite one another upon said front column, and immediately above said lower end thereof;
said forward end of said left and said right trailing arm being pivotally attached respectively to said left and said right trailing arm attachment point of said front column;
15 a yoke attachment point disposed circumferentially rearwardly substantially midway between said left and said right trailing arm attachment point of said front column;
a yoke pivotally secured to said yoke attachment point of said front column;
20 said yoke directly contacting and pivotally linking said left and said right trailing arm together such that said left and said right trailing arm each subtend arcs equal to one another and in directions opposite to one another when arcuately pivoted respectively about said left and said right trailing arm attachment point of said front column;
25 surface contact means extending from said rearward end of each said trailing arm;
a steering shaft having an upper end and a lower end opposite said upper end, and concentrically disposed within said front column; and
30 a single surface contact means extending from said lower end and steering means extending from said upper end of said steering shaft.
- 35 2. The cambering vehicle according to claim 1, wherein said yoke comprises an upper and a lower bar connected by a central link.

with each said bar being parallel to one another and capturing said left and said right trailing arm therebetween adjacent to each said forward end thereof, with said central link including a pivot passage centrally disposed therethrough for pivotally securing said yoke to said yoke attachment point of said front column.

3. The cambering vehicle according to claim 1, including a single removable fastener for removably securing said yoke to said yoke attachment point of said front column and folding said front column adjacent said left and said right trailing arm when said yoke is removed.

4. The cambering vehicle according to claim 1, wherein at least said surface contact means of each said trailing arm comprises a wheel, with each said wheel including a brake and each said brake being controlled independently from one another by a separate brake control disposed upon said steering means and communicating with each said brake.

5. The cambering vehicle according to claim 1, including trailing arm stop means disposed upon said front column, for limiting arcuate movement of each said trailing arm.

6. The cambering vehicle according to claim 1, wherein said steering means comprises handlebars.

7. The cambering vehicle according to claim 1, wherein said surface contact means of each said trailing arm and said steering shaft is selected from the group consisting of wheels, wheeled skates, ice skates, and skis.

8. A cambering vehicle, comprising:
a frame comprising a front column and a left and a right trailing arm;
said front column having an upper end and a lower end opposite said upper end;
each said trailing arm having a forward end and a rearward end opposite said forward end;

a left and a right trailing arm attachment point disposed opposite one another upon said front column, and immediately above said lower end thereof;

5 said forward end of said left and said right trailing arm being pivotally attached respectively to said left and said right trailing arm attachment point of said front column;

10 means for interconnecting said left and said right trailing arm together such that said left and said right trailing arm each subtend arcs equal to one another and in directions opposite to one another when arcuately pivoted respectively about said left and said right trailing arm attachment point of said front column;

a single wheel extending from said rearward end of each said trailing arm;

15 a steering shaft having an upper end and a lower end opposite said upper end, and concentrically disposed within said front column;

a single wheel extending from said lower end and steering means extending from said upper end of said steering shaft;

20 brake means disposed with said wheel of each said trailing arm; and

separate and independent brake control means for each said brake means disposed upon said steering means and communicating with said brake means for separate and independent control thereof.

25 9. The cambering vehicle according to claim 8, wherein said means for interconnecting said left and said right trailing arm together comprises:

a yoke attachment point disposed circumferentially rearwardly substantially midway between said left and said right trailing arm attachment point of said front column; and

30 a yoke pivotally secured to said yoke attachment point of said front column, and directly communicating with and pivotally linking said left and said right trailing arm together.

10. The cambering vehicle according to claim 9, wherein said yoke comprises an upper and a lower bar connected by a central link;

each said bar being parallel to one another and capturing said left and said right trailing arm therebetween adjacent to each said forward end thereof; and

5 said central link including a pivot passage centrally disposed therethrough for pivotally securing said yoke to said yoke attachment point of said front column.

10 11. The cambering vehicle according to claim 9, including a single removable fastener for removably securing said yoke to said yoke attachment point of said front column and folding said front column adjacent said left and said right trailing arm when said yoke is removed.

12. The cambering vehicle according to claim 9, including trailing arm stop means disposed upon said front column, for limiting arcuate movement of each said trailing arm.

15 13. The cambering vehicle according to claim 8, wherein said steering means comprises handlebars.

14. A cambering vehicle, comprising:

 a frame comprising a front column and a left and a right trailing arm;

20 said front column having an upper end and a lower end opposite said upper end;

 each said trailing arm having a forward end and a rearward end opposite said forward end;

25 a left and a right trailing arm attachment point disposed opposite one another upon said front column, and immediately above said lower end thereof;

 said forward end of said left and said right trailing arm being pivotally attached respectively to said left and said right trailing arm attachment point of said front column;

30 a yoke attachment point disposed circumferentially rearwardly substantially midway between said left and said right trailing arm attachment point of said front column;

 a yoke pivotally secured to said yoke attachment point of said front column;

said yoke directly contacting and pivotally linking said left and said right trailing arm together such that said left and said right trailing arm each subtend arcs equal to one another and in directions opposite to one another when arcuately pivoted respectively about said left and said right trailing arm attachment point of said front column;

a single removable fastener for removably securing said yoke to said yoke attachment point of said front column and folding said front column adjacent said left and said right trailing arm when said yoke is removed;

surface contact means extending from said rearward end of each said trailing arm;

a steering shaft having an upper end and a lower end opposite said upper end, and concentrically disposed within said front column; and

a single surface contact means extending from said lower end and steering means extending from said upper end of said steering shaft.

15. The cambering vehicle according to claim 14, wherein said yoke comprises an upper and a lower bar connected by a central link, with each said bar being parallel to one another and capturing said left and said right trailing arm therebetween adjacent to each said forward end thereof, with said central link including a pivot passage centrally disposed therethrough for pivotally securing said yoke to said yoke attachment point of said front column.

16. The cambering vehicle according to claim 14, wherein at least said surface contact means of each said trailing arm comprises a wheel, with each said wheel including a brake and each said brake being controlled independently from one another by a separate brake control disposed upon said steering means and communicating with each said brake.

17. The cambering vehicle according to claim 14, including trailing arm stop means disposed upon said front column, for limiting arcuate movement of each said trailing arm.

18. The cambering vehicle according to claim 14, wherein said steering means comprises handlebars.

19. The cambering vehicle according to claim 14, wherein said surface contact means of each said trailing arm and said steering shaft are selected from the group consisting of wheels, wheeled skates, ice skates, and skis.

20. A cambering vehicle, comprising:

a frame comprising a front column and a left and a right trailing arm;

10 said front column having an upper end and a lower end opposite said upper end;

each said trailing arm having a forward end and a rearward end opposite said forward end;

15 a left and a right trailing arm attachment point disposed opposite one another upon said front column, and immediately above said lower end thereof;

said forward end of said left and said right trailing arm being pivotally attached respectively to said left and said right trailing arm attachment point of said front column;

20 a link attachment point disposed circumferentially rearwardly substantially midway between said left and said right trailing arm attachment point of said front column;

a transverse link having a left and a right end, pivotally secured to said link attachment point of said front column;

25 elastomeric arm connecting means disposed at said left end and said right end of said link;

said link directly connecting and pivotally linking said left and said right trailing arm together such that said left and said right trailing arm each subtend arcs substantially equal to one another and in directions opposite to one another when arcuately pivoted respectively about said left and said right trailing arm attachment point of said front column;

30 surface contact means extending from said rearward end of each said trailing arm;

a steering shaft having an upper end and a lower end opposite said upper end, and concentrically disposed within said front column; and

5 a single surface contact means extending from said lower end and steering means extending from said upper end of said steering shaft.

21. The cambering vehicle according to claim 20, wherein:

10 said link further comprises a single torsionally and arcuately rigid rod having a pivot passage centrally disposed therethrough for pivotally securing said link to said link attachment point of said front column;

each said end of said link including an elastomeric bushing thereon, having an elastomer material disposed therein;

15 each said trailing arm including a link end connecting passage therethrough; and

each said elastomeric bushing installed in said link end connecting passage of a corresponding said trailing arm, for directly and resiliently connecting each said trailing arm together.

20 22. The cambering vehicle according to claim 20, further including folding means for each said trailing arm, for folding said front column adjacent said left and said right trailing arm when each said arm is folded.

25 23. The cambering vehicle according to claim 20, wherein at least said surface contact means of each said trailing arm comprises a wheel, with each said wheel including a brake and each said brake being controlled independently from one another by a separate brake control disposed upon said steering means and communicating with each said brake.

30 24. The cambering vehicle according to claim 20, further including vehicle stabilizing and upright parking means, comprising:

each said elastomeric arm connection means comprising an elastomeric bushing having an elastomer material disposed therein; and

said elastomer material of each said bushing providing increasing angular deflection and torsional resistance to arcuate displacement of each said trailing arm from a central disposition, thereby urging each said trailing arm toward the central disposition and generally parallel orientation with one another.

25. The cambering vehicle according to claim 20, wherein said steering means comprises handlebars.

26. The cambering vehicle according to claim 20, wherein said surface contact means of each said trailing arm and said steering shaft is selected from the group consisting of wheels, wheeled skates, ice skates, and skis.

27. A cambering vehicle, comprising:

a frame comprising a front column and a left and a right trailing arm;

15 said front column having an upper end and a lower end opposite said upper end;

each said trailing arm having a forward end and a rearward end opposite said forward end;

20 a left and a right trailing arm attachment point disposed opposite one another upon said front column, and immediately above said lower end thereof;

said forward end of said left and said right trailing arm being pivotally attached respectively to said left and said right trailing arm attachment point of said front column;

25 means for interconnecting said left and said right trailing arm together such that said left and said right trailing arm each subtend arcs equal to one another and in directions opposite to one another when arcuately pivoted respectively about said left and said right trailing arm attachment point of said front column;

30 a single wheel extending from said rearward end of each said trailing arm;

a steering shaft having an upper end and a lower end opposite said upper end, and concentrically disposed within said front column;

a single wheel extending from said lower end and steering means extending from said upper end of said steering shaft;

brake means disposed with said wheel of each said trailing arm; and

5 separate and independent brake control means for each said brake means disposed upon said steering means and communicating with said brake means for separate and independent control thereof.

10 28. The cambering vehicle according to claim 27, wherein said means for interconnecting said left and said right trailing arm together further comprises:

a link attachment point disposed circumferentially rearwardly substantially midway between said left and said right trailing arm attachment point of said front column;

15 a transverse link having a left and a right end, pivotally secured to said link attachment point of said front column;

elastomeric arm connecting means disposed at said left end and said right end of said link; and

20 said link directly connecting and pivotally linking said left and said right trailing arm together such that said left and said right trailing arm each subtend arcs substantially equal to one another and in directions opposite to one another when arcuately pivoted respectively about said left and said right trailing arm attachment point of said front column.

25 29. The cambering vehicle according to claim 28, wherein: said link further comprises a single torsionally and arcuately rigid rod having a pivot passage centrally disposed therethrough for pivotally securing said link to said link attachment point of said front column;

30 each said end of said link including an elastomeric bushing thereon, having an elastomer material disposed therein;

each said trailing arm including a link end connecting passage therethrough; and

each said elastomeric bushing installed in said link end connecting passage of a corresponding said trailing arm, for

directly and resiliently connecting each said trailing arm together.

30. The cambering vehicle according to claim 28, further including vehicle stabilizing and upright parking means, comprising:

5 each said elastomeric arm connecting means comprising an elastomeric bushing having an elastomer material disposed therein; and

10 said elastomer material of each said bushing providing increasing angular deflection and torsional resistance to arcuate displacement of each said trailing arm from a central disposition, thereby urging each said trailing arm toward the central disposition and generally parallel orientation with one another.

31. The cambering vehicle according to claim 27, further including folding means for each said trailing arm, for folding said front column adjacent said left and said right trailing arm when each
15 said arm is folded.

32. The cambering vehicle according to claim 27, wherein said steering means comprises handlebars.

33. A cambering vehicle, comprising:

20 a frame comprising a front column and a left and a right trailing arm;

said front column having an upper end and a lower end opposite said upper end;

25 each said trailing arm having a forward end and a rearward end opposite said forward end;

a left and a right trailing arm attachment point disposed opposite one another upon said front column, and immediately above said lower end thereof;

30 said forward end of said left and said right trailing arm being pivotally attached respectively to said left and said right trailing arm attachment point of said front column;

a link attachment point disposed circumferentially rearwardly substantially midway between said left and said right trailing arm attachment point of said front column;

a transverse link having a left and a right end, pivotally secured to said link attachment point of said front column;

elastomeric arm connecting means disposed at said left end and said right end of said link;

5 said link directly connecting and pivotally linking said left and said right trailing arm together such that said left and said right trailing arm each subtend arcs substantially equal to one another and in directions opposite to one another when arcuately pivoted respectively about said left and said right trailing arm attachment point of said front column;

10 folding means for each said trailing arm, for folding said front column adjacent said left and said right trailing arm when each said arm is folded;

15 surface contact means extending from said rearward end of each said trailing arm;

a steering shaft having an upper end and a lower end opposite said upper end, and concentrically disposed within said front column; and

20 a single surface contact means extending from said lower end and steering means extending from said upper end of said steering shaft.

34. The cambering vehicle according to claim 33, wherein:

25 said link further comprises a single torsionally and arcuately rigid rod having a pivot passage centrally disposed therethrough for pivotally securing said link to said link attachment point of said front column;

each said end of said link including an elastomeric bushing thereon, having an elastomer material disposed therein;

30 each said trailing arm including a link end connecting passage therethrough; and

each said elastomeric bushing installed in said link end connecting passage of a corresponding said trailing arm, for directly and resiliently connecting each said trailing arm together.

35 35. The cambering vehicle according to claim 33, wherein at least said surface contact means of each said trailing arm comprises a

wheel, with each said wheel including a brake and each said brake being controlled independently from one another by a separate brake control disposed upon said steering means and communicating with each said brake.

- 5 36. The cambering vehicle according to claim 33, further including vehicle stabilizing and upright parking means, comprising:

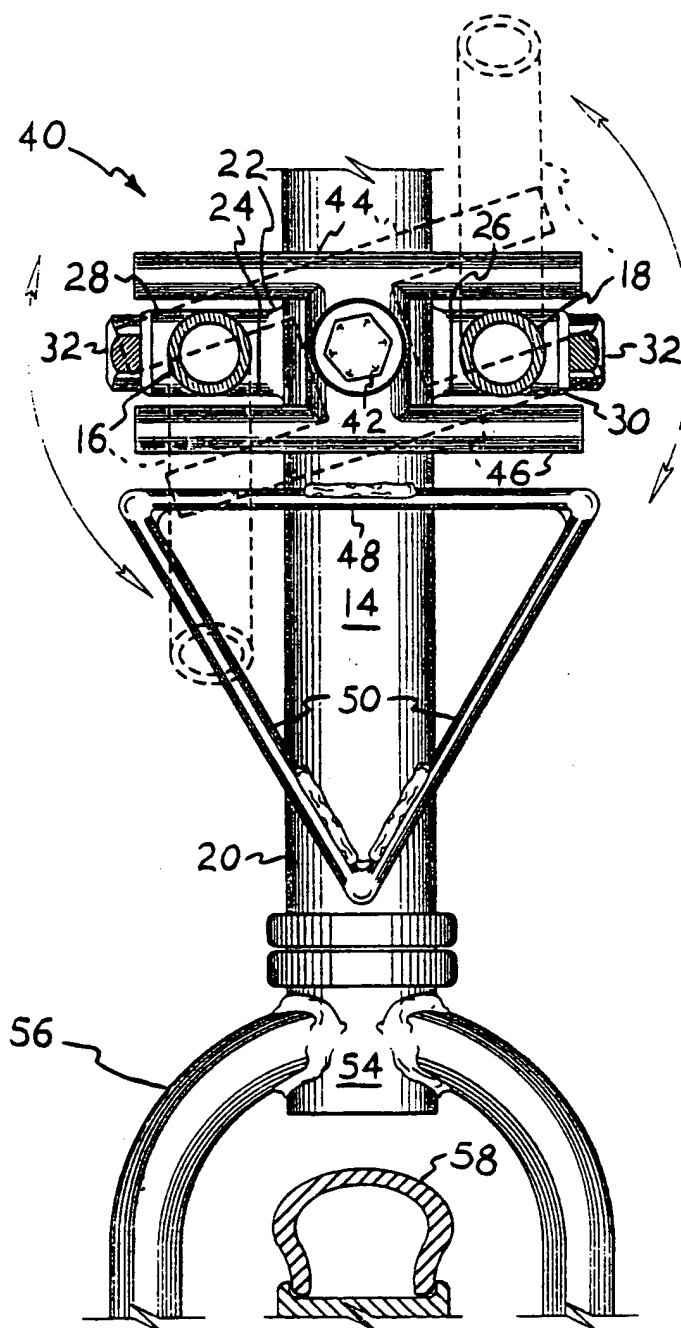
each said elastomeric arm connecting means comprising an elastomeric bushing having an elastomer material disposed therein; and

- 10 said elastomer material of each said bushing providing increasing angular deflection and torsional resistance to arcuate displacement of each said trailing arm from a central disposition, thereby urging each said trailing arm toward the central disposition and generally parallel orientation with one another.

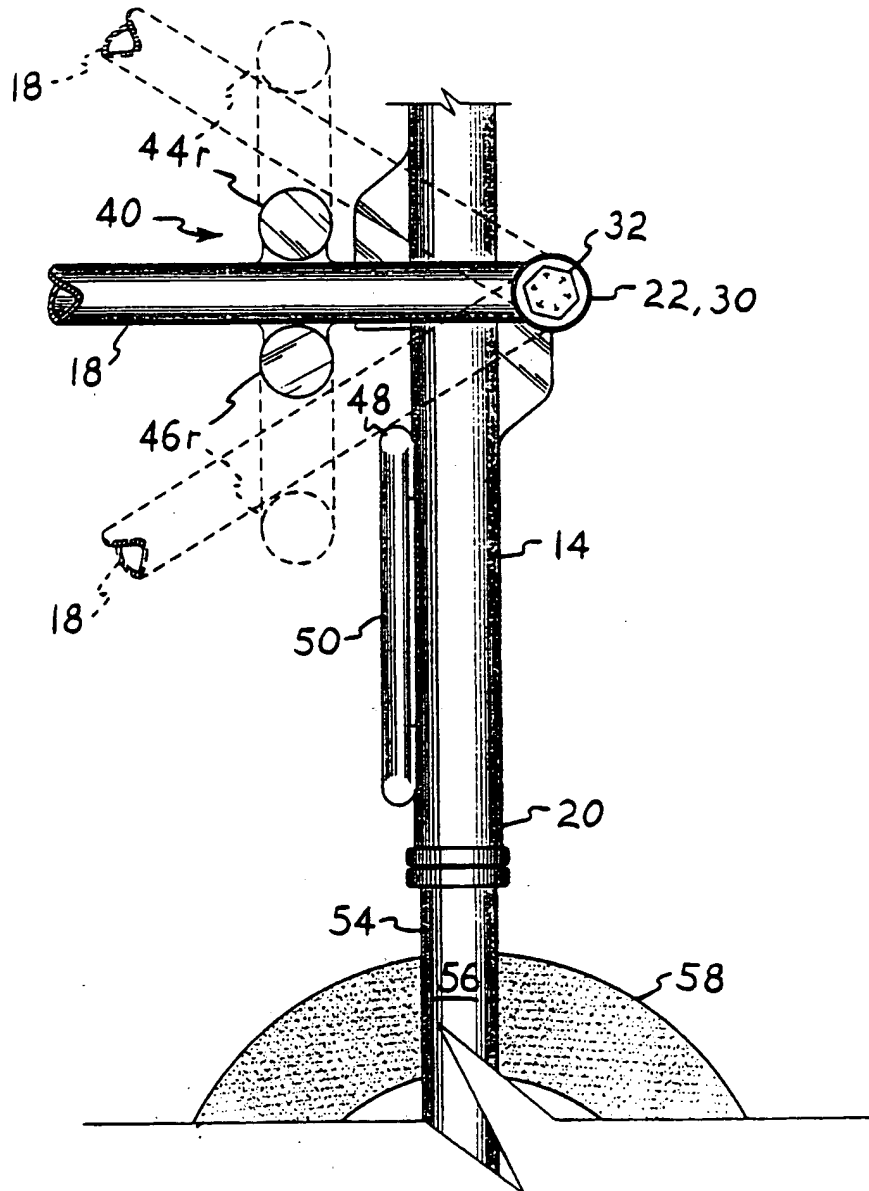
- 15 37. The cambering vehicle according to claim 33, wherein said steering means comprises handlebars.

- 20 38. The cambering vehicle according to claim 33, wherein said surface contact means of each said trailing arm and said steering shaft are selected from the group consisting of wheels, wheeled skates, ice skates, and skis.

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**FIG. 2**

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**FIG. 3**

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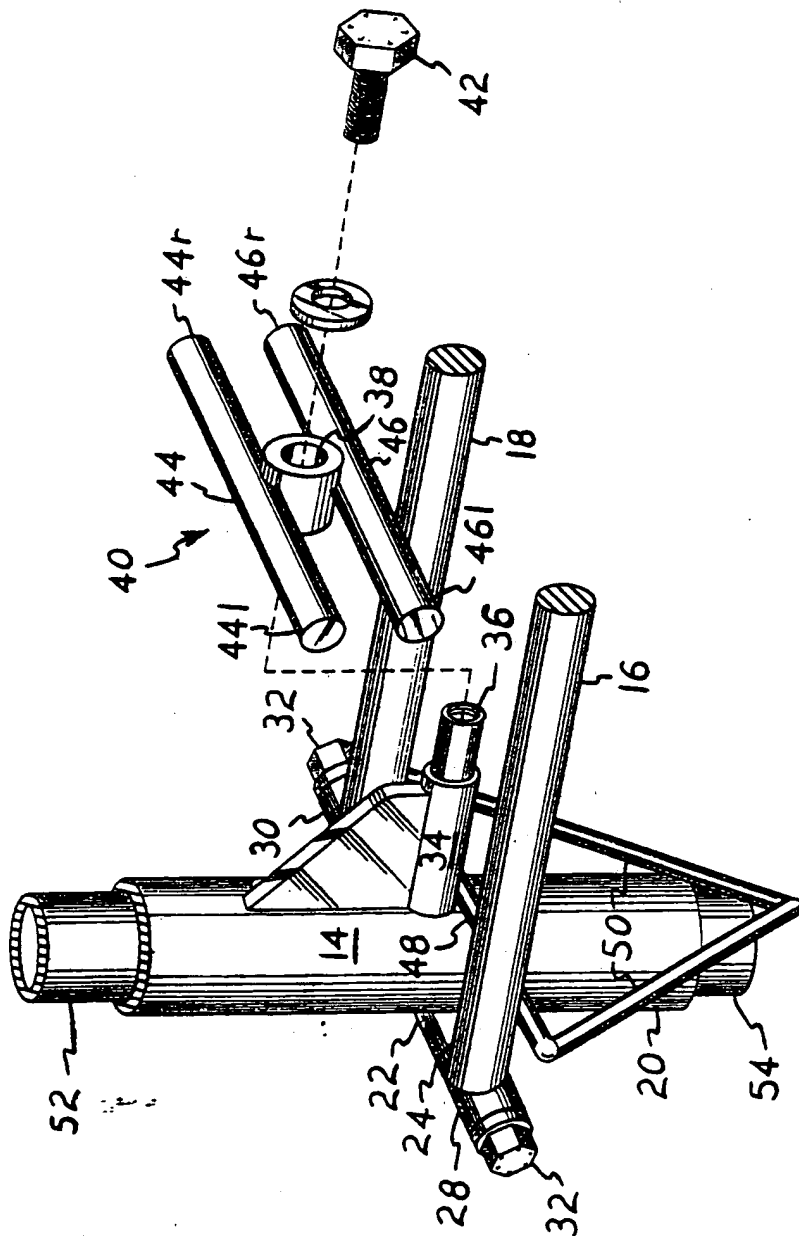
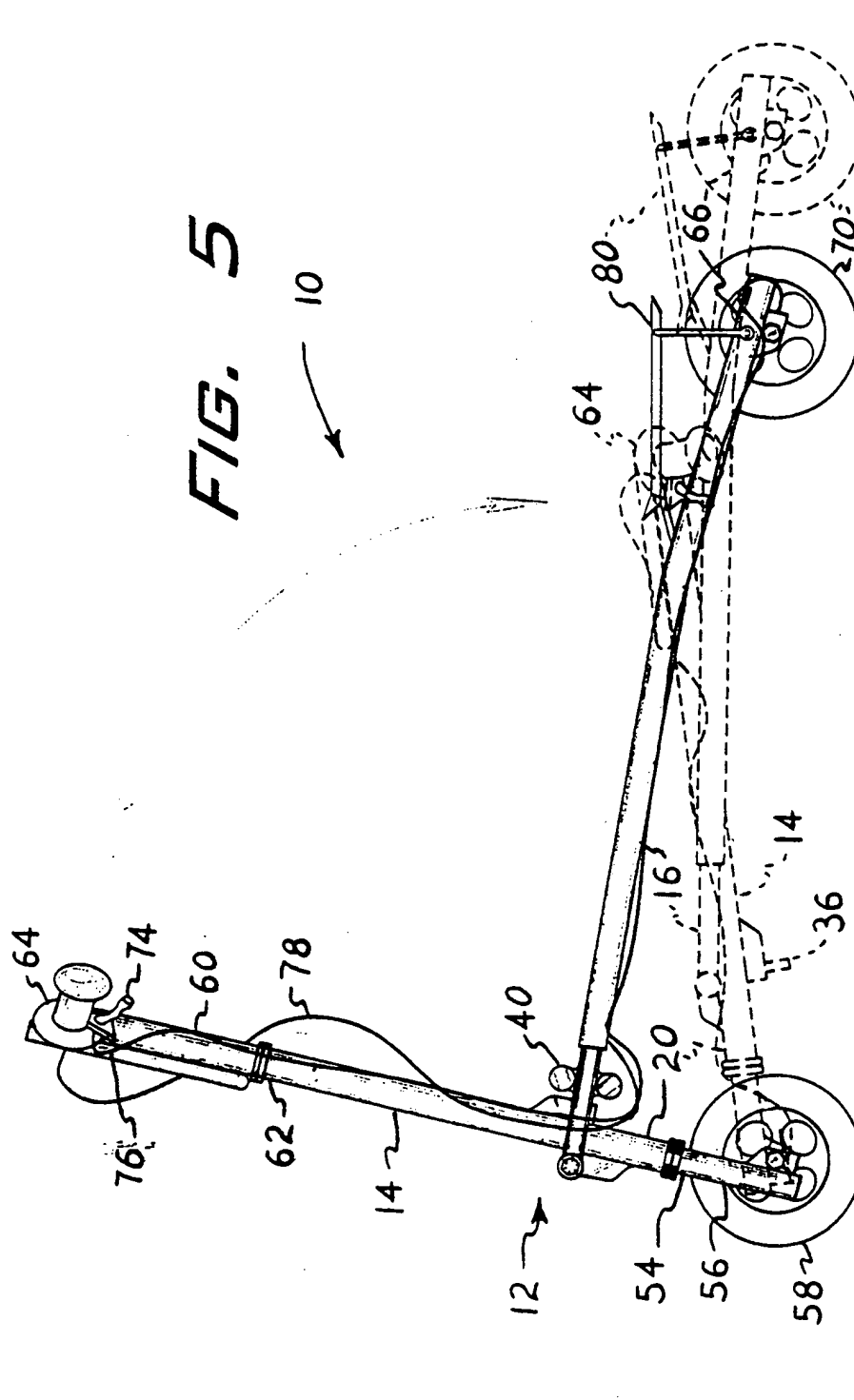


FIG. 4



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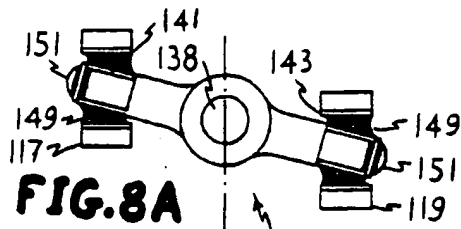


FIG. 8A

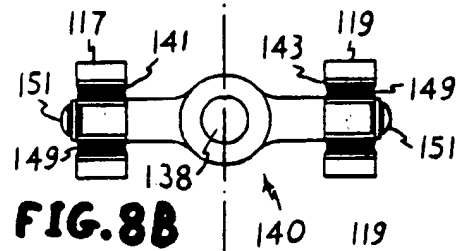


FIG. 8B

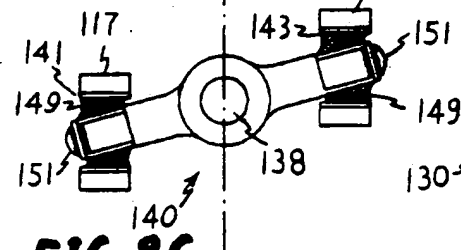


FIG. 8C

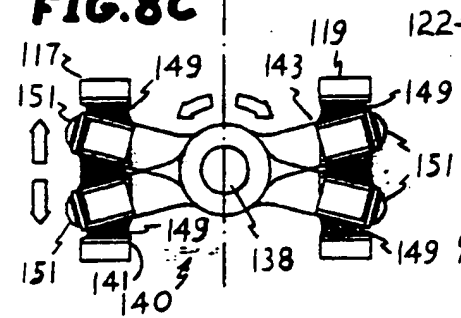


FIG. 8D

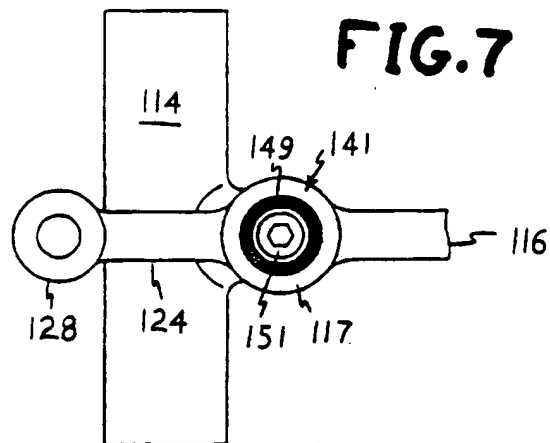


FIG. 7

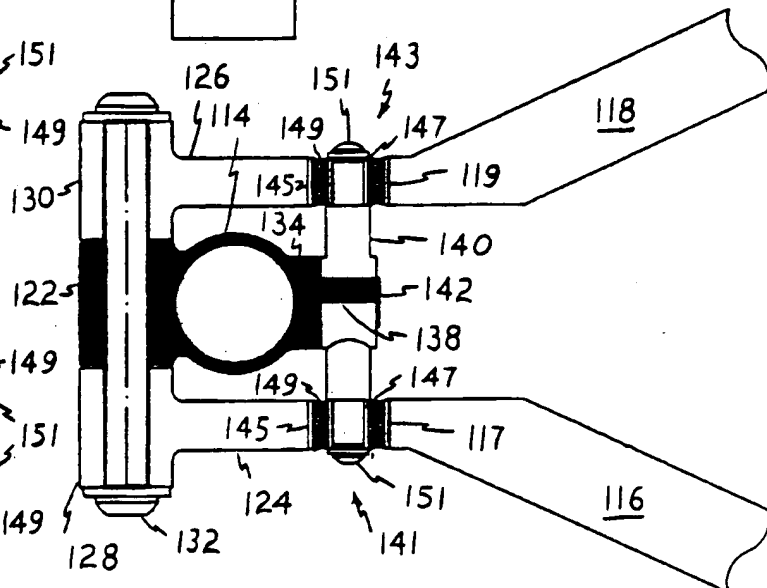


FIG. 6

